

LAKE BRYANT

REPORT DESCRIPTION

This report is an update on the health of Lake Bryant based on water quality data collected from 1994 through 2012 by citizen volunteers and Snohomish County Surface Water Management (SWM) staff. For additional background on the information provided here or to find out more about Lake Bryant, please visit www.lakes.surfacewater.info or call SWM at 425-388-3464.

LAKE DESCRIPTION

Lake Bryant is a 21-acre lake located about three miles northwest of Arlington. Lake Bryant has a maximum depth of 7 meters (23 feet). The lake is a kettle, an almost circular depression, formed by a large ice block left behind during the last Ice Age. Anecdotal evidence indicates that the lake was mostly drained in the first half of the 20th century to expand the surrounding agricultural lands. The water level has returned to historic depths in recent decades. The lake shoreline is largely undeveloped, but the watershed or area draining to the lake has both agricultural and residential areas. The watershed, which is the land area that drains to the lake, is large, covering 463 acres, which is about 22 times the size of the lake. This means that there is a greater potential for impacts from the watershed than at a lake with a small watershed.

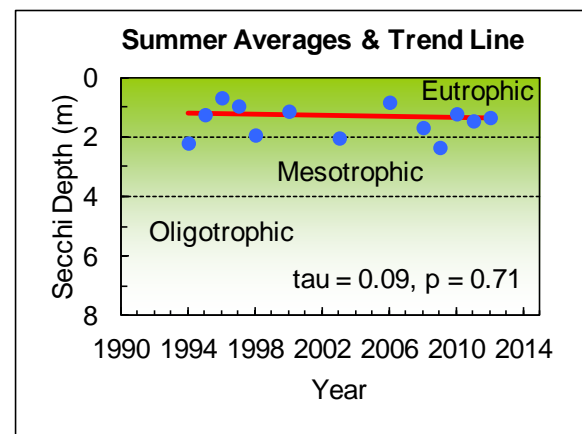
LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (in red) for water clarity, total phosphorus, and chlorophyll *a* for Lake Bryant. Please refer to the table at the end of the report for long-term averages and for averages and ranges for individual years.

Water Clarity

The water clarity of a lake, measured with a Secchi disk, is a reading of how far one can see into the water. Water clarity is affected by the amount of algae and sediment in the lake, as well as by water color. Lakes with high water clarity usually have low amounts of algae, while lakes with poor water clarity often have excessive amounts of algae.

The water clarity in Lake Bryant is low and variable, with a long-term summer average of 1.4 meters (4.6 feet). Since 1994, there have been no significant trends in water clarity. The low water clarity is caused, in part, by the naturally dark color of the lake water.



Water Color

The color of lake water affects water clarity and the depths at which algae and plants can grow. In many lakes, the water is naturally brown, orange, or yellow. This darker color comes from dissolved humic compounds from surrounding wetlands and does not harm water quality. Measurements of true water color provide clues to changes in water clarity. True water color is only the color from dissolved materials and not of the color of algae or sediment suspended in the water.

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The water color of Lake Bryant averaged 108 pcu (platinum-cobalt color units) in 2010 – 2011, which indicates a significant amount of color in the lake water. The color was somewhat darker than during 1994 – 1995, when the average was 97 pcu. Lake Bryant is one of the darkest-colored lakes in Snohomish County, and the color seems to vary somewhat from year to year. The dark water color is a major factor in the low water clarity readings and in the annual variations in water clarity.

Temperature

The temperature of lake water changes with the seasons and varies with depth. During spring and summer, the sun warms the upper waters. Because warmer water is less dense, it floats above the cooler, denser water below. The temperature and density differences create distinct layers of water in the lake, and these layers do not mix easily. This process is called stratification and occurs during the warm months. The warm, upper water layer is called the epilimnion. The colder, darker bottom zone is called the hypolimnion. These layers will stay separated until the fall when the upper waters cool, the temperature differences decrease, and the entire lake mixes, or turns over.

From June through September 2011, temperature data were collected at each meter throughout the Lake Bryant water column. Temperature profiles for 2011 (see graph) show that throughout the sampling season the lake was strongly thermally stratified. This means that there is a large temperature difference between the warm upper waters and the cool bottom waters, and mixing does not occur between these layers. In June the upper waters measured about 69° F (20.5°C) in temperature, and by August had reached their peak at 70° F (21°C). At the same time, bottom water temperatures measured 48°F (9°C) throughout

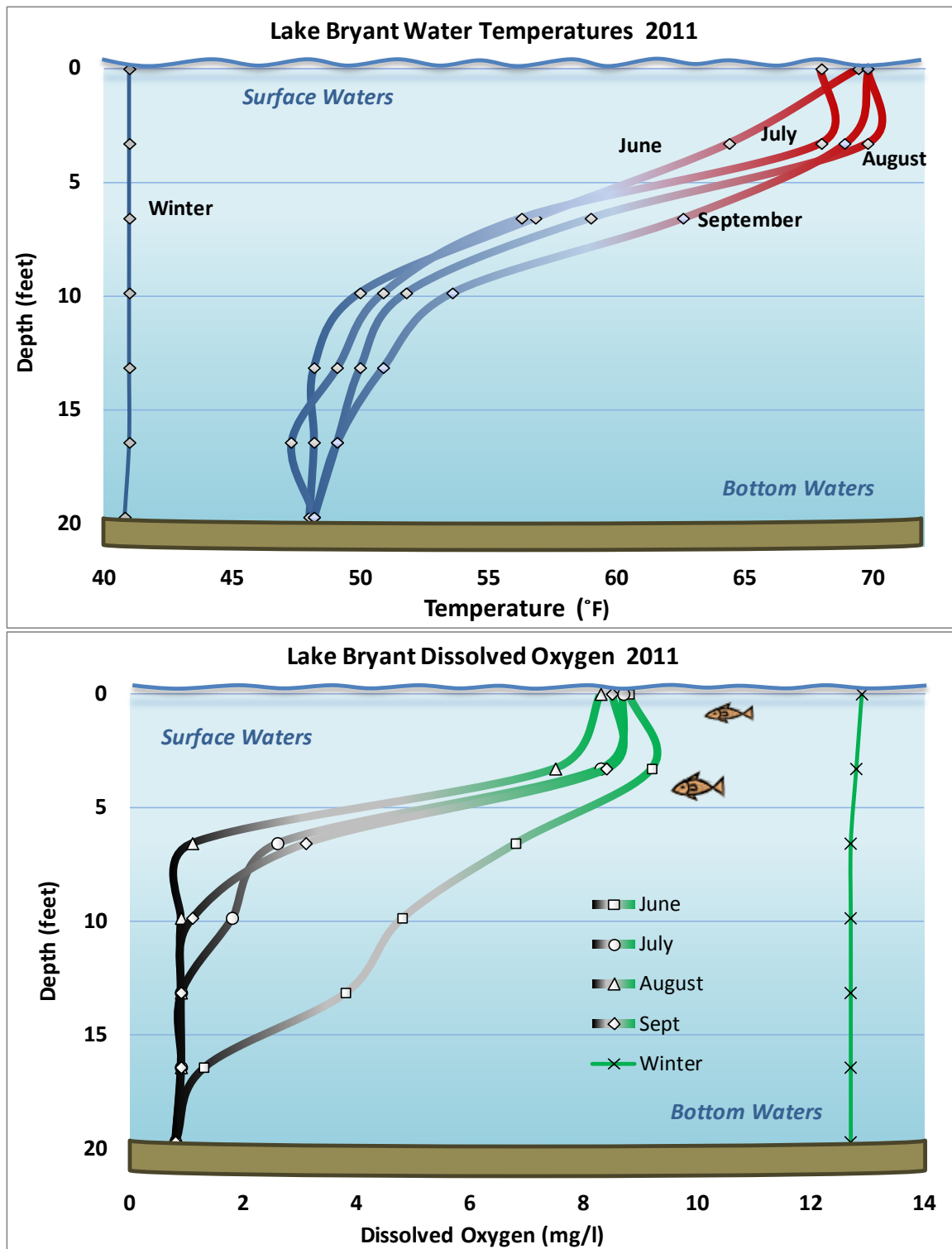
the summer. Each fall the surface waters will cool until the temperatures are almost equal from top to bottom. As stratification weakens, the lake water will turn over (or mix). The lake will stay mixed during the winter until springtime, when the upper waters began to warm again.

Dissolved Oxygen

Oxygen dissolved in the water is essential for life in a lake. Most of the dissolved oxygen comes from the atmosphere. Like temperature, dissolved oxygen levels vary over time and with depth. During the warm months, the upper waters receive oxygen from the atmosphere, but the lower waters cannot be replenished with oxygen because of the separation between water layers. Meanwhile, bacteria in the lake bottom are consuming oxygen as they decompose organic matter. Eventually oxygen is depleted in the bottom waters. Low dissolved oxygen in the bottom waters can lead to a release of nutrients from the lake sediments.

Dissolved oxygen was also measured at every meter throughout the Lake Bryant water column from June to September in 2011 (see graph). Oxygen levels were relatively high in the upper waters throughout the sampling period, while the bottom waters contained much less oxygen. There was little or no oxygen in the water below about 17 feet in June. Then, from July to September, the zone of low oxygen steadily expanded. During the stratified summer period, oxygen in the lower waters is consumed by the decomposition of organic material within the lake. When the lake is stratified, the oxygen is not replenished by the overlying oxygen-rich upper waters or the atmosphere. The bottom of the lake will remain devoid of oxygen until the lake mixes (typically in late October/early November). The lake then remains mixed until springtime when the upper waters begin to warm and dissolved oxygen begins to decline again in the bottom.

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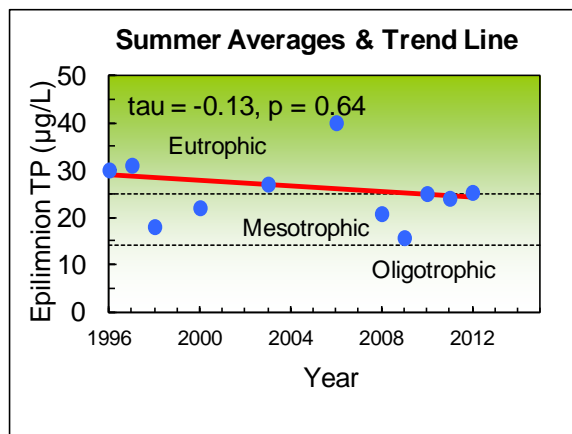


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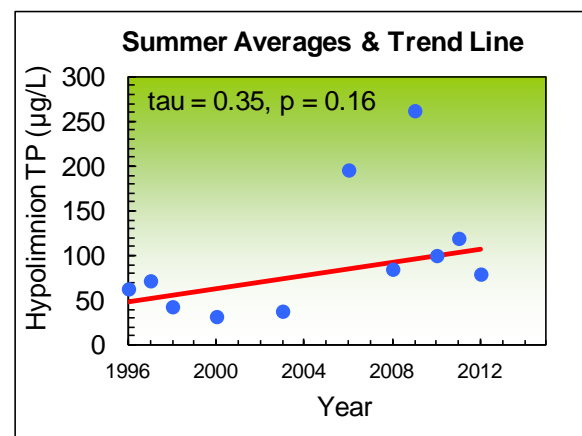
Phosphorus (key nutrient for algae)

Nutrients are essential for the growth of algae, fish, and aquatic plants in a lake. However, too many nutrients, especially phosphorus, can pollute a lake and lead to unpleasant algae growth. Nutrients enter the lake through stormwater runoff or from streams flowing into the lake. Sources of nutrients include fertilizers, pet and animal wastes, poorly-maintained septic systems and erosion from land clearing and construction. Monitoring of phosphorus levels over time helps to identify changes in nutrient pollution.

Total phosphorus concentrations in the epilimnion (upper waters) are moderately high, with a long-term 1996 – 2012 summer average of 25 µg/l (micrograms per liter, which is equivalent to parts per billion). Between 1996 and 2012, there has been no statistically significant trend in phosphorus levels. However, there is a high level of annual variability. In part, this may be due to the limited number of samples taken in the years prior to 2008.



Phosphorus values in the hypolimnion (bottom waters) are also high, with a long-term summer average of 99 µg/l. In 2006 and 2009, the averages were significantly higher at 196 and 262 µg/l, respectively. The phosphorus averages dropped to between 80 and 120 µg/l in 2010 through 2012. High levels of phosphorus in the bottom waters are the result of a buildup of phosphorus in the sediments. The phosphorus is then released during periods of low dissolved oxygen and may become available for algae growth. Increasing phosphorus levels could be an indication of accelerating lake eutrophication. Even though there appears to be an increasing trend in phosphorus concentrations in the hypolimnion, it is not statistically significant because of the wide variations between years.



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Chlorophyll *a* (Algae)

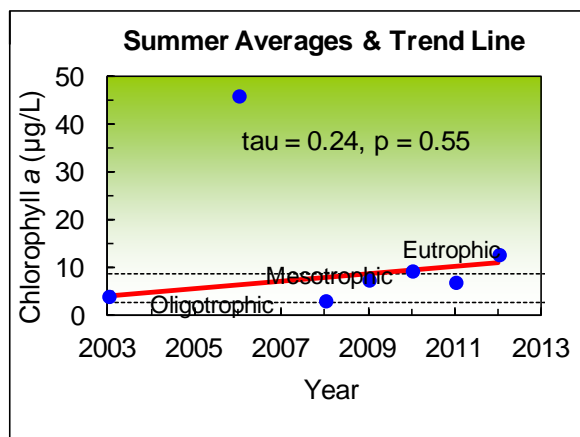
Algae are tiny plant-like organisms that are essential for a healthy lake. Fish and other lake life depend on algae as the basis for their food supply. However, excessive growths of algae, called algae blooms, can cloud the water, form unsightly scums, and sometimes release toxins. Excess nutrients, such as phosphorus, are the main cause of nuisance algae growth in a lake. Chlorophyll *a* measurements are one method for tracking the amount of algae in a lake.

There are limited chlorophyll *a* data for Lake Bryant, with only six years of recent sampling and only a single sample in two of those years. The 2003 to 2012 long-term summer average is 13 µg/l. This long-term average is greatly influenced by one sample taken in 2006 that was 46 µg/l—three times higher than any other individual reading. Likely this sample was taken during a severe algae bloom. Between 2008 and 2012, the summer averages ranged from 3.1 to 13 µg/l. These averages indicate moderate to dense algae growth. Given the limited data, there does not appear to be any trend in chlorophyll *a* values in the lake. However, moderate to high levels of algae have been measured regularly at Lake Bryant, and occasional algae blooms have been observed.

SHORELINE CONDITION

The lake shoreline condition is important in understanding the overall lake health. Frequently, lake shorelines are modified either through removal of natural vegetation and/or the installation of bulkheads or other hardening structures. This type of alteration can be harmful to the lake ecosystem because natural shorelines protect the lake from harmful pollution, prevent bank erosion, and provide important habitat for fish and wildlife.

Lake Bryant has the least developed shoreline of all lowland lakes in Snohomish County. There are no homes directly on the lake, there are no docks, and the shoreline vegetation is 100% intact, although some of the plant community is dominated by non-native species. Intact vegetation means the shoreline is primarily bordered by tall grasses, trees and shrubs. There is also a moderate amount (about 43 pieces) of large wood still remaining in the lake. These old logs and branches are valuable for fish and wildlife habitat.



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SUMMARY

Trophic State

All lakes go through a process of enrichment by nutrients and sediment. In this process, known as eutrophication, nutrients and sediment contribute to the ever-increasing growth of algae and aquatic plants. Over thousands of years, lakes will gradually fill up with organic matter and sediments.

Lakes can be classified by their degree of eutrophication, also known as their trophic state. There are three primary trophic states for lakes—oligotrophic, mesotrophic, and eutrophic—as well as intermediate states. Oligotrophic lakes are usually deep, with clear water, low nutrient concentrations, and few aquatic plants and algae. Mesotrophic lakes are richer in nutrients and produce more algae and aquatic plants. Eutrophic lakes are often shallow and characterized by abundant algae and plants, high nutrient concentrations, limited water clarity, and low dissolved oxygen in the bottom waters.

The trophic state classification of a lake does not necessarily indicate good or bad water quality because eutrophication is a natural process. However, human activities that contribute sediment and excess nutrients to a lake can dramatically accelerate the eutrophication process and result in declining water quality.

Based on the long-term monitoring data, Lake Bryant may be classified as a eutrophic lake, with low water clarity, high phosphorus levels, and moderate to high levels of algae. This appears to be the natural condition for this shallow, kettle lake.

Condition and Trends

Overall, Lake Bryant is in healthy condition for a eutrophic lake. In the 2003 State of the Lakes Report, the targets of maintaining water clarity and phosphorus levels were identified. With five additional years of data, there have been no significant changes in water clarity or in phosphorus concentrations in the upper waters. In contrast, the long-term average of phosphorus in the bottom waters has been increasing in recent years, but at this time there is no statistically significant trend toward higher phosphorus levels.

Regular monitoring of the lake should continue in order to determine if phosphorus levels in the bottom waters and chlorophyll *a* levels will continue increasing.

The primary threat to Lake Bryant's water quality is the possibility of an increase in nutrients from new development or other human activities in the watershed, such as agriculture. Lake Bryant is more susceptible to nutrient pollution given its large watershed size. However, the wetlands surrounding the lake should help filter inputs if additional development occurs. In order to protect the healthy condition of the lake, measures should be taken to control nutrients in the watershed. To find out more about the causes and problems of elevated lake nutrient levels and to obtain tips to improve lake water quality please visit www.lakes.surfacewater.info.

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DATA SUMMARY FOR LAKE BRYANT					
Source	Date	Water Clarity (Secchi depth in meters)	Total Phosphorus (ug/l)		Chlorophyll a (ug/l)
			Surface	Bottom	Epilimnion
Bortleson, et al, 1976	8/6/1974	0.6	29	33	-
Sumioka and Dion, 1985	7/7/81	0.9	10	10	11
SWM Staff or Volunteer	1994	1.6 - 2.6 (2.2) n = 4	-	-	5.5 - 6.4 (6.0) n = 2
SWM Staff or Volunteer	1995	1.2 - 1.3 (1.2) n = 3	-	-	13
SWM Staff	1996	0.6 - 0.7 (0.7) n = 2	29 - 31 (30) n = 2	53 - 73 (63) n = 2	-
SWM Staff	1997	0.8 - 1.1 (0.9) n = 2	26 - 36 (31) n = 2	47 - 97 (72) n = 2	-
SWM Staff	8/11/98	1.9	18	43	-
SWM Staff	6/14/00	1.1	22	32	-
SWM Staff	7/24/03	2.0	27	38	4.0
SWM Staff	7/24/06	0.8	40	196	46
Volunteer	2008	1.3 - 2.0 (1.7) n=4	15 - 32 (21) n=4	43 - 152 (85) n=4	2.1 - 4.3 (3.1) n=4
SWM Staff or Volunteer	2009	2.2 - 2.4 (2.3) n = 3	15 - 17 (16) n = 3	233 - 296 (262) n = 3	4.0 - 9.8 (7.4) n = 3
SWM Staff or Volunteer	2010	1 - 1.5 (1.2) n = 4	14 - 43 (25) n = 4	54 - 153 (100) n = 4	6.4 - 13 (9.3) n = 4
SWM Staff or Volunteer	2011	1 - 2.0 (1.4) n = 4	19 - 29 (24) n = 4	51 - 205 (120) n = 4	2.7 - 16 (7.0) n = 4

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Source	Date	Water Clarity (Secchi depth in meters)	Total Phosphorus (ug/l)		Chlorophyll a (ug/l)
			Surface	Bottom	Epilimnion
SWM Staff or Volunteer	2012	1.1 - 1.6 (1.3) <i>n</i> = 4	18 - 29 (25) <i>n</i> = 4	35 - 123 (80) <i>n</i> = 4	4.3 - 22 (13) <i>n</i> = 4
Long Term Avg		1.4 (1994-2012)	25 (1996-2012)	99 (1996-2012)	13 (2003-2012)
TRENDS		None	None	None	None

NOTES

- Table includes summer (May-Oct) data only.
- Each box shows the range on top, followed by summer average in () and number of samples (*n*).
- Total phosphorus data are from samples taken at discrete depths only.
- "Surface" samples are from 1 meter depth and "bottom" samples are from 1-2 meters above the bottom.